APPENDIX F REASONABLE FORESEEABLE DEVELOPMENT

1. REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

At this time it is unknown when, where, or if future well sites or roads might be proposed on any leased parcel, or even if a lease would be issued. Should a lease be issued, site specific analysis of individual wells or roads would occur when a lease holder submits an APD (Application for Permit to Drill).

For the purpose of analysis the BLM has created a Reasonably Foreseeable Development (RFD) scenario, which helps identify and quantify direct, indirect, and cumulative effects of oil and gas activity. These numbers are used for analysis purpose only and carry with them no guarantees of lease issuance or subsequent development. The RFD is 690 wells on 161 parcels, with an estimated total surface disturbance of 3396.5 acres. It is assumed that each parcel would have at least one well developed within it. If proven to be capable of production in paying quantities, that is the minimum requirement to hold a lease. The surface disturbance associated with the well(s) (well pad, access road, etc.) could be located on or off the parcels depending on the parcel's stipulations. Please refer to the RFD for the assumed wells and disturbance per parcel.

When estimating the number of wells per parcel, the BLM assumed a 40-acre down hole spacing on each parcel, unless there were State-issued spacing orders that stipulated otherwise, and also considered oil and gas production ongoing in a mile radius around each parcel over the last few years. When estimating the surface disturbance per well, the BLM referred to assumption in existing field development NEPA documents that overlapped the parcels. Where there were no existing NEPA documents the BLM extrapolated disturbance assumptions from the Greater Uintah Basin Technical Support Document (BLM, 2012), which estimated the total number of wells per pad, and the total acreage of disturbance in the Greater Uintah Basin area.

The following sections provide a general discussion of possible post-leasing RFD activities. All of these activities would require additional NEPA review.

a. Well Pad and Road Construction

Equipment for well pad construction would consist of dozers, excavators, backhoes, scrapers, and graders. Topsoil from each well pad would be stripped to an approximate depth of six inches and stockpiled for future reclamation. The size of the well pad would be determined by size of the drilling rig, number of wells on the pad, and type of well-being drilled. The well pad would be constructed of native material and might have gravel placed on it to maintain year round access.

It is anticipated that new or upgraded access roads would be required to access well pads and maintain production facilities. Construction of new roads or upgrades to existing roads would usually require a 30-foot construction width and would be constructed of native material. Any new roads constructed for the purpose of oil and gas development would be utilized year-round for maintenance of the proposed well and other facilities, and for the transportation of fluids and/or equipment, and would remain open to other land users. The type of equipment required for these activities would be the same as those needed for well pad construction. Please refer to Appendix G for the well pad and road assumptions per parcel.

b. Well Drilling and Completion Operations

Once construction or expansion of an individual well pad is completed, drilling equipment would be moved onto the new well pad. It is assumed that wells would be drilled utilizing a conventional, mechanically-powered mobile drilling rig. The exact type and size and engine tier of drilling rig would be dependent upon rig availability at the time of project implementation. Drilling operations would consist of drilling the hole, running and cementing intermediate casing, drilling the production hole, and running and cementing production casing. Water required for the drilling and completion of the proposed gas wells would be hauled by truck from a combination of the permitted water sources. It is estimated that approximately 3 acre-feet of water would be needed for the drilling and completion (including hydrofracturing) of one well. For the purposes of this document it is assumed that the water would be obtained from a fresh water source that would be depleting to the Colorado River System.

The casing and cementing program would be designed to isolate and protect the shallower formations, especially usable ground water, encountered in the well bore as directed by BLM Utah Instruction Memorandum (IM) 2010-055 and to prohibit pressure communication or fluid migration between zones. The cement would protect the well by preventing formation pressure from damaging the casing and by retarding corrosion by minimizing contact between the casing and formation fluids. The type of casing used and the depth to which it is set would depend upon the physical characteristics of the formations that are drilled. Site-specific descriptions of drilling procedures would be included in the APD and the COAs for each well.

If testing indicates economic potential, completion operations would set production casing to the total drilled depth, perforate the casing in target production zones, and may hydraulically fracture the productive formation under high pressure. The hydraulic fracturing material would contain sand or other proppant material to keep the fractures open, thereby allowing hydrocarbons to flow more freely into the casing. The next phase would be to flow and test the well to determine rates of production.

i. Hydraulic Fracturing

Hydraulic fracturing (HF) is a well stimulation technique used to increase oil and gas production from underground rock formations. As summarized below, HF technology is not used on all wells drilled in the VFO, MFO, and SLFO. As a result, HF will be evaluated at the APD stage should the parcel be leased, and a development proposal submitted. The following paragraphs provide a general discussion of the HF process that could potentially be implemented if development were to occur, including well construction information and general conditions encountered within the VFO, MFO, and SLFO.

HF involves the injection of fluids through a wellbore under pressures great enough to fracture the oil and gas producing formations. The fluid is generally comprised of a liquid such as water and proppant (commonly sand or ceramic beads), and a minor percentage of chemicals to give the fluid desirable flow characteristics, corrosion inhibition, etc. The amount of water used in a HF cannot be exactly determined at the leasing stage because it depends on the depth of the well, the number of completions done on the well, and the HF fluid composition. However, for the purposes of this analysis, the three acre-feet of water needed for the completion operations is assumed to be sufficient to satisfy the needs for hydrofracturing. The proppant holds open the

newly created fractures after the injection pressure is released. Oil and gas flow through the fractures and up the production well to the surface.

HF has been used by oil and natural gas producers since the late 1940s and, for the first 50 years, was mostly used in vertical wells in conventional formations. HF is still used in these settings, but the process has evolved. Technological developments (including horizontal drilling) have led to the use of HF in "unconventional" hydrocarbon formations that could not otherwise be profitably produced.

The use of horizontal drilling through unconventional reservoirs combined with high-volume water based multi-stage HF activities has led to an increase in oil and gas activity in several areas of the country which has, in turn, resulted in a dramatic increase in domestic oil and gas production nationally. However, along with the production increase, HF activities are suspected of causing contamination of fresh water by creating fluid communication between oil and gas reservoirs and aquifers. In 2016, the EPA conducted an assessment of HF on drinking water resources (https://www.epa.gov/hfstudy).

c. Production Operations

If wells were to go into production, facilities could be located at the well pad or off location and typically include a well head, a dehydrator/separator unit, and storage tanks for produced fluids. The production facility would typically consist of two storage tanks, a truck load-out, separator, and dehydrator facilities. Oil wells will also have a pump jack on the well head. Construction of the production facility would be located on the well pad and not result in any additional surface disturbance.

All permanent surface structures would be painted a flat, non-reflective color (e.g., Juniper Green, Carlsbad Canyon, Shadow Gray) specified by the BLM in order to blend with the colors of the surrounding natural environment. Facilities that are required to comply with the Occupational Safety and Health Act (OSHA) would be excluded from painting color requirements. All surface facilities would be painted immediately after installation and under the direction and approval of the BLM.

If oil is produced, the oil would be stored on location in tanks and the majority transported by truck to a refinery with a smaller portion being transported by pipeline. The volume of tanker truck traffic for oil production would be dependent upon production of the wells, however, it is estimated oil would be transported to a Salt Lake City refinery at least once a week, in 280-barrel tanker trucks.

If natural gas is produced, construction of a gas pipeline would be necessary to transport the gas. An additional Sundry Notice, right of way (ROW) and NEPA analysis would be completed, as needed, for any pipelines and/or other production facilities across public lands if not included in the original APD. BLM Best Management Practices (BMPs), such as burying the pipeline or installing the pipeline within the road, would be considered at the time of the proposal. Please refer to Section 2 of this Appendix for the pipeline assumptions per parcel.

All operations would be conducted following the "Gold Book" Surface Operating Standards for Oil and Gas Exploration and Development. The Gold Book was developed to assist operators by providing information on the requirements for conducting environmentally responsible oil and

gas operations on federal lands. The Gold Book provides operators with a combination of guidance and standards for ensuring compliance with agency policies and operating requirements, such as those found at 43 CFR 3000; Onshore Oil and Gas Orders (Onshore Orders); and Notices to Lessees. Included in the Gold Book are environmental BMPs; these measures are designed to provide for safe and efficient operations while minimizing undesirable impacts to the environment.

Periodically, a workover or recompletion on a well may be required to ensure that efficient production is maintained. Workovers can include repairs to the well bore equipment (casing, tubing, rods, or pump), the wellhead, or the production facilities. These repairs would usually be completed in 7 days per well, during daylight hours. The frequency for this type of work cannot be accurately projected because workovers vary by well; however, an average work time may be one workover per well per year after about 5 years of production. In the case of a recompletion, where the wellbore casing is worked on or valves and fittings are replaced to stimulate production, all by-products would be stored in tanks and hauled from the location. For workover operations, it may be necessary to rework the surface location to accommodate equipment. At the completion of the work, the surface location would be re-graded and reclaimed to pre-existing conditions.

Exploration and development on split-estate lands is also addressed in the Gold Book, along with IM 2003-131, Permitting Oil and Gas on Split-Estate Lands and Guidance for Onshore Oil and Gas Order No. 1, IM 2007-165, Split-Estate Report to Congress – Implementation of Fluid Mineral Leasing and Land Use Planning Recommendations, and PIM 2018-014 Directional Drilling into Federal Mineral Estate from Well Pads on Non-Federal Locations (Fee-Fee-Fed IM). Proper planning and consultation, along with the proactive incorporation of these BMPs into the APD Surface Use Plan of Operations by the operator typically result in a more efficient APD and environmental review process, increased operating efficiency, reduced long-term operating costs, reduced final reclamation needs, and less impact to the environment.

d. Produced Water Handling

Water is often associated with either produced oil or natural gas. Water is separated out of the production stream and can be temporarily stored in the reserve pit for 90 days. Permanent disposal options include discharge to evaporation pits or underground injection. Handling of produced water is addressed in Onshore Oil and Gas Order No. 7.

e. Maintenance Operations

Traffic volumes during production would be dependent upon whether the wells produced natural gas and/or oil, and for the latter, the volume of oil and/or water produced.

Well maintenance operations may include periodic use of work-over rigs and heavy trucks for hauling equipment to the producing well, and would include inspections of the well by a pumper on a regular basis or by remote sensing. The road and the well pad would be maintained for reasonable access and working conditions.

f. Plugging and Abandonment

If the well does not produce economic quantities of oil or gas, or when it is no longer commercially productive, the well would be plugged and abandoned. Wells would be plugged and abandoned following procedures reviewed by a BLM Petroleum Engineer and Geologist, and approved by the Authorized Officer. Plugging would include cement plugs at strategic positions in the well bore. Surface disturbance would be reclaimed according to the standards established by the Green River District Reclamation Guidelines.

2. WELL NUMBER AND ACREAGE ESTIMATES

Parcel ID	Parcel Acres	Maximum Number of Wells Allowed on Parcel (Total Acreage / Spacing Index)	Maximum Disturbance Per Parcel	Reasonably Foreseeable Number Of Wells	Surface Disturbance for Estimated Number of Wells (Acres)	County	Acreage Assumptions from Development Documents
098	39.70	1	5	1	5	Uintah	GUB TSD[3]
105	84.07	2	1	2	10	Uintah	GUB TSD[3]
114	1925.04	48	241	3	15	Uintah	GUB TSD[3]
116	2426.43	60	303	3	15	Uintah	GUB TSD[3]
120	558.58	8	45	2	10	Uintah	GUB TSD[3]
125	669.29	2	10	2	10	Uintah	GUB TSD[3]
128	1597.35	40	15	7	35	Uintah	GUB TSD[3]
137	1905.29	47	238	2	10	Uintah	GUB TSD[3]
140	1563.77	39	195	5	25	Uintah	GUB TSD[3]
147	39.96	1	5	1	5	Uintah	GUB TSD[3]
150	401.18	10	50	10	50	Uintah	GUB TSD[3]
152	1997.14	10	55	10	55	Uintah	GNB EIS[4]
153	2443.73	44	1100	10	45	Uintah	RH EA[5]
154	2135.13	252	36	10	45	Uintah	RH EA[5]
155	2564.68	64	321	10	50	Uintah	GUB TSD[3]
156	230.77	5	29	5	25	Uintah	GUB TSD[3]
157	1246.27	15	76	10	50	Uintah	GUB TSD[3]
158	1982.92	49	248	5	25	Uintah	GUB TSD[3]
159	1590.52	40	2	4	20	Uintah	GUB TSD[3]
160	2556.17	63	320	5	25	Uintah	GUB TSD[3]
161	792.13	19	1	2	10	Uintah	GUB TSD[3]
163	1998.45	49	250	4	20	Uintah	GUB TSD[3]
166	318.17	7	40	1	5	Uintah	GUB TSD[3]
180	474.81	11	59	10	50	Uintah	GUB TSD[3]
181	1118.67	23	120	3	15	Uintah	GUB TSD[3]

Parcel ID	Parcel Acres	Maximum Number of Wells Allowed on Parcel (Total Acreage / Spacing Index)	Maximum Disturbance Per Parcel	Reasonably Foreseeable Number Of Wells	Surface Disturbance for Estimated Number of Wells (Acres)	County	Acreage Assumptions from Development Documents
182	1991.32	49	249	4	20	Uintah	GUB TSD[3]
183	1757.00	5	27	5	25	Uintah	GUB TSD[3]
184	1597.09	39	195	3	15	Uintah	GUB TSD[3]
185	1753.94	43	219	4	20	Uintah	GUB TSD[3]
187	1981.52	49	248	4	20	Uintah	GUB TSD[3]
188	2300.10	57	285	5	25	Uintah	GUB TSD[3]
189	1196.04	29	145	2	10	Uintah	GUB TSD[3]
190	2557.93	63	315	5	25	Uintah	GUB TSD[3]
191	2519.71	62	310	5	25	Uintah	GUB TSD[3]
192	2350.83	58	290	5	25	Uintah	GUB TSD[3]
193	2388.59	59	295	5	25	Uintah	GUB TSD[3]
194	1912.24	47	235	4	20	Uintah	GUB TSD[3]
195	1320.14	33	165	3	15	Uintah	GUB TSD[3]
196	678.34	16	80	2	10	Uintah	GUB TSD[3]
209	234.80	5	25	1	5	Uintah	GUB TSD[3]
210	73.03	1	9	1	5	Uintah	GUB TSD[3]
215	1189.04	29	145	8	40	Uintah	GUB TSD[3]
219	2152.83	53	265	7	35	Uintah	GUB TSD[3]
220	1399.22	34	170	7	35	Uintah	GUB TSD[3]
221	1865.83	46	230	4	20	Uintah	GUB TSD[3]
222	1588.57	39	195	3	15	Uintah	GUB TSD[3]
223	2490.36	61	305	5	25	Uintah	GUB TSD[3]
224	2527.37	63	315	5	25	Uintah	GUB TSD[3]
225	2553.16	63	315	5	25	Uintah	GUB TSD[3]
233	39.74	1	6	1	5.5	Uintah	GNB EIS[4]

Parcel ID	Parcel Acres	Maximum Number of Wells Allowed on Parcel (Total Acreage / Spacing Index)	Maximum Disturbance Per Parcel	Reasonably Foreseeable Number Of Wells	Surface Disturbance for Estimated Number of Wells (Acres)	County	Acreage Assumptions from Development Documents
234	328.43	8	44	8	44	Uintah	GNB EIS[4]
235	79.72	1	5	1	5	Uintah	GUB TSD[3]
236	80.06	1	5	1	5	Uintah	GUB TSD[3]
237	79.98	1	5	1	5	Uintah	GUB TSD[3]
238	120.09	3	15	1	5	Uintah	GUB TSD[3]
265	2145.61	3	15	3	15	Uintah	GUB TSD[3]
267	2069.06	51	255	4	20	Uintah	GUB TSD[3]
288	1276.04	31	155	10	50	Uintah	GUB TSD[3]
294	39.91	1	5	1	5	Uintah	GUB TSD[3]
297	1040.00	26	130	2	10	Grand	GUB TSD[3]
313	623.40	15	75	9	45	Uintah	GUB TSD[3]
350	1302.15	32	160	3	15	Uintah	GUB TSD[3]
352	2550.79	63	315	5	25	Uintah	GUB TSD[3]
353	2041.29	51	255	4	20	Uintah	GUB TSD[3]
354	1573.03	39	195	3	15	Uintah	GUB TSD[3]
355	1542.14	38	190	3	15	Uintah	GUB TSD[3]
357	1841.78	46	230	3	15	Uintah	GUB TSD[3]
Total	**93,812.42**	**2,323**	**10,857**	**292**	**1,459.5**		

1 **Gasco EIS** Assume 3.5 acres of disturbance per well including the well pad, road, and pipeline based on the Gasco Uinta Basin FEIS Table 2-7. The Gasco ROD allowed 1 well pad per 160 acres. It is assumed that only one well would be drilled on the pad until more production information is available.

2 Gasco EIS Although this parcel is located within the boundary of the Gasco Uinta Basin EIS, no development assumed in this Township and Range under any alternatives due to the area not being leased, or due to the leases belonging to other companies. Therefore the Greater Uinta Basin Technical Support Document assumptions should be used.

3 GUB TSD Assume 5 acres of disturbance per well including the well pad, road, and pipeline based on table 4.1 in the Greater Uinta Basin Technical Support Document. Number derived from data in Table 4-1 by dividing total foreseeable

Parcel ID	Parcel Acres	Maximum Number of Wells Allowed on Parcel (Total Acreage / Spacing Index)	Maximum Disturbance Per Parcel	Reasonably Foreseeable Number Of Wells	Surface Disturbance for Estimated Number of Wells (Acres)	County	Acreage Assumptions from Development Documents
construction disturbance by the total foreseeable new well pads. Pads, roads, and pipelines counted together in this estimate. **4 GNB EIS** Assume 5.5 acres of disturbance per well including the well pad, road, and pipeline based on the ROD section 3. The Greater Natural Buttes ROD allowed 1 well pad per 80 acres. It is assumed that only one well would be drilled on the pad until more production information is available. **5 RH EA** Assume 4.5 acres of disturbance per well including the well pad, road, and pipeline based on Rock House EA Chapter 2. The Rock House state director decision allowed 9 well pads total. It is assumed that any development would be drilled on one of those nine well pads until more production information is available. **6 West Bonanza** Assume 4 acres of disturbance per well including the well pad, road, and pipeline based on the proposed action of the West Bonanza EA. The West Bonanza EA Decision Record allowed 1 well pad per 80 or greater acres. It is assumed that each well pad will have one well on it, until further production information is available.							

3. REFERENCES

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